NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
LYNDON B. JOHNSON SPACE CENTER (JSC)

JUSTIFICATION FOR OTHER THAN FULL AND OPEN COMPETITION (JOFOC) OVER $100,000 PURSUANT TO 10 U.S.C. 2304(c)(1) and FEDERAL ACQUISITION REGULATION (FAR) 6.302-1

Orion Multi-Purpose Crew Vehicle (MPCV) Cockpit Prototyping Phase 4 (OCPP4)

1. This document is a justification for other than full and open competition prepared by the NASA JSC.

2. The nature and/or description of the action being approved:

The JSC proposes to contract with Aerospace Applications North America, Inc. (AANA) by other than full and open competition for the acquisition of Orion MPCV OCPP4 support. It is the Government's intention to award a follow-on contract to the Crew Exploration Vehicle (CEV) Cockpit Prototyping Phase 1 Contract (CCPP1C), NNJ06HC04P; the CEV Cockpit Prototyping Phase 2 Contract (CCPP2C), NNJ06TA10B; and the CEV Cockpit Prototyping Phase 3 Contract (CCPP3C), NNJ09TA62B. CCPP1C, CCPP2C, and CCPP3C were awarded non-competitively to AANA based on FAR 6.302-1, only one responsible source and no other supplies or services will satisfy Agency requirements. The JOFOC for CCPP1C was approved in November 2005, for CCPP2C in April 2006, and for CCPP3C in March 2009.

3. Description of the supplies or services required, including the estimated value:

The functional elements to be performed for the Orion MPCV OCPP4 consist of providing human machine interface research and development activities to NASA for rapid prototyping Orion MPCV display and control concepts. This is accomplished by the creation of simulations for Orion MPCV display and electronic procedure formats, software display navigation schemes, and the hardware devices required to interface with the Orion MPCV software. An integral part of Phase 4 is to further develop the tools and concepts created during CCPP1C, CCPP2C, and CCPP3C. In addition to this requirement, the contractor shall integrate concepts, tools, and lessons learned from several other next generation human machine interface projects: the Crew Rescue Vehicle (CRV) human machine development effort, the X-38 Remote Cockpit Van Project, the Advanced Cockpit Evaluation System (ACES), and the Sensor Fusion Project.

The OCPP4 Contract will be a fixed-price Indefinite Delivery Indefinite Quantity (IDIQ) contract. The period of performance will be 5 years. June 1, 2014, through May 31, 2019, with a minimum IDIQ value of $50,000 and maximum value of $1,500,000.

4. Statutory authority permitting other than full and open competition:

The statutory authority permitting this action falls within FAR 6.302-1(a)(2)(iii), "Only One Responsible Source and No Other Supplies or Services Will Satisfy Agency Requirements," pursuant to 10 U.S.C. 2304(c)(1). Per FAR 6.302-1, services may be deemed to be available from only the original source in the case of follow-on services for the continued provision of highly specialized services when it is likely that award to any other source would result in substantial duplication of cost to the Government that are not expected to be recovered through competition and unacceptable delays in fulfilling the Agency's requirements.

5. A demonstration that the proposed contractor's unique qualifications or the nature of the acquisition requires use of the authority cited:

NASA is developing a new spacecraft, the Orion MPCV. AANA will be responsible for integrating Orion MPCV display and control concept ideas into a set of Orion MPCV cockpit simulators. AANA has been working with the Flight Test Branch and the Astronaut Office for 14 years. They began with the creation of prototype displays and controls for the CRV cockpit. This work also included the creation of a remote cockpit for the X-38. The cockpit was built into a 15 passenger van and positioned on the ground at Edwards Air Force Base where real-time data and video were fed into the cockpit to create the environment of being on board the X-38 during a flight test. AANA participated in the display and control software design, build-up, and flight testing of this cockpit.

Under the CCPP1C, AANA provided technical support by designing a CEV cockpit layout simulator and a CEV display simulator.

During the CCPP2C, AANA completed development of a C++/Graphics Library (GL) Studio Orion Cockpit Prototyping environment including display logic and graphics code separation, as well as a reusable object oriented library of graphical components. This software environment was completely designed and implemented over a 3-year timeframe by AANA.

AANA's ability to use the environment they designed to quickly create animated prototype displays and their associated procedures is critical to NASA, as over 86 displays have to be designed, updated, and validated over a 2-year timeframe. Display design and validation includes the initial display concept implementation, but also includes changes to be made to the display based on evaluation results. AANA is able to generate a typical system display prototype in less than 3 days, while market research indicates that the avionics industry standard is over 3 weeks. AANA cockpit prototyping engineers also designed a very flexible system and electronic procedure simulator, which allows them to implement each procedure and its associated scenario in less than a day. Since modifications can be made quickly by AANA, the impact of any interface redesign is minimized enabling more flexibility to design the optimal interface for Orion.

During CCPP3C, AANA developed a generic display software 'engine' that has permitted more than half of the 86 Orion MPCV displays to be converted to the streamlined generic format from the baseline hardcoded format, resulting in significant software economy while providing important flexibility. AANA has unique knowledge of this important software component of the Orion MPCV display software.

During CCPP3C, AANA has extended the capability of the eProc electronic procedure system to meet operational requirements required by the crew and Mission Operations Directorate while remaining well within software scope constraints dictated by the Orion MPCV Program. They have realized the required capabilities of this essential element of the Orion MPCV cockpit while simultaneously reducing the code complexity by an order of magnitude from prior estimates. AANA has unique knowledge of this essential component of the Orion MPCV display software.

During CCPP3C, AANA has extended the capability of their vehicle simulator to permit simulations of complete Orion flight phases while permitting complex malfunctions and timelines to be modeled. This simulation approach has been proven during the performance of more than 20 Orion MPCV display and cockpit evaluations by NASA astronauts and has culminated with the first use of the Medium Fidelity Mockup in the Space Vehicle Mockup Facility in Building 9 at JSC. This first use was the performance of the Orion MPCV Ascent Abort Evaluations, which included participation by 20 astronauts. AANA provided all display software, simulation software, and software support during this important milestone. Numerous additional crew evaluations will be required to complete the Orion MPCV cockpit as the Design Reference Mission tasks and vehicle equipment become better defined in the future. Because of AANA's intimate knowledge of all aspects of the Orion display software and simulation system, AANA is uniquely positioned to provide this future support.

During CCPP3C, AANA has begun converting the existing GL Studio display models into the IData development environment. GL Studio is the commercial display development tool used for initial prototyping the Orion MPCV display software. The Orion MPCV Program and prime contractor have selected another commercial tool, IData, for production and have requested that the existing models be converted into IData. Because of AANA's knowledge of the existing GL Studio models and their knowledge of IData, AANA is uniquely positioned to perform this conversion and to continue to develop the displays and simulations in IData, which will be required for all future Orion MPCV work.

During CCPP3C, AANA has worked with Rapid Prototyping Lab (RPL) and the Orion MPCV Program to help RPL begin development of a source code parsing tool developed in the Practical Extraction And Reporting Language or equivalent. This parsing tool permits the display prototype code to be analyzed and to have data extracted. This extracted data is useful for the display documentation, simulator scenario development, requirements definition, and is relevant to the flight software certification process.

During CCPP3C, AANA has worked with RPL and the Orion MPCV Program to apply software developed during the X-38/CRV Project, the ACES Project, and the Sensor Fusion Project to help create the Debris Avoidance Tool. This is a laptop application flown on board the chase helicopter during the Orion parachute drop tests. The debris tool provides chase crews detailed information about the location of debris descending in the sky from the drop tests, so the helicopter can avoid this debris while remaining close to the descending Orion spacecraft to safely obtain critical test video data. This tool has been used during the past 10 Orion drop tests, and will be used during the Exploration Flight Test-1 maiden Orion flight test. AANA has unique knowledge of this tool and has unique experience since they developed much of it, performed the initial flight tests, and currently train Orion and Department of Defense personnel to use it.

During CCPP3C, AANA developed software Graphics Processing Unit (GPU) in collaboration with JSC Engineering and the Orion Project. This work has demonstrated the capability of producing computer graphics without a graphics card by emulating a graphics card with an embedded computer similar to radiation-hardened computers widely used on spacecraft. Radiation in space interferes with the operation of modern electronics that are not hardened against radiation effects. Because radiation-hardened graphics cards do not exist, and since computer graphics have replaced physical displays and controls in modern avionics, the demonstration of the software GPU is of great interest to the Orion Project and for manned spaceflight in general. This demonstration involves detailed knowledge of embedded computers, real-time operating systems such as VxWorks, and of the Orion IData based computer graphics. AANA has unique knowledge in these areas based on their work on this demonstration.

During CCPP3C, AANA has performed preliminary studies with the Orion MPCV prime contractor to begin definition of a largely automated requirements communication process. This process will culminate with Orion MPCV display software requirements being placed in the DOORS database, the official software requirements repository for Orion MPCV. Some or all display requirements may also be documented in the IBM Rational Rhapsody tool. AANA has created pathfinder studies for both the DOORS and IBM Rational Rhapsody processes.

Due to AANA's intimate knowledge of the prototype code, the existing parsing tool, simulator scenario construction, and the current state of the evolving automated display software requirements definition and communication processes, AANA is uniquely positioned to continue to perform these tasks.

AANA's previous experience and familiarity with the development of cockpit displays, controls, menu navigation, electronic procedures, and caution and warning systems is extensive and critical to successful performance. The cost involved in training new personnel and development of new systems would be excessive to the Government and unrecoverable through competition. In addition, the time to complete the training of new personnel would cause excessive delays in the Orion MPCV schedule and the Agency would encounter unacceptable delays in meeting its requirements. Therefore, AANA is the only technically capable source to continue this activity.

6. Description of the efforts made to ensure that offers are solicited from as many potential sources as practicable:

A synopsis for this effort was issued on the NASA Acquisition Internet Service (NAIS) on November 19, 2013. The synopsis closed on December 9, 2014, and one response was received (See Section 9). The acquisition was included on the Center's Annual Acquisition Forecast. A review of the Consolidated Contracting Initiative Home Page did not result in the identification of contract vehicle that could be used for this support.

7. Description of the market survey conducted and the results, or a statement of the reasons a market survey was not conducted:

A survey of eight avionics manufacturers was conducted in order to locate a company capable of providing the required service in the required timeframe. The survey included a review of vendor literature for specific expertise and products that would match the requirements. Results are as follows:

a. Honeywell Bendix/King possesses an extensive list of avionics products for general aviation; including systems integration, data processing systems, adaptive antenna systems, human factors engineering, navigation systems, hazard avoidance systems, weather radar, multi-function control and display units, flight controls, and flight information services. Honeywell also provides space onboard processing systems, guidance navigation and control products for various space platforms, and satellite flight control systems.

b. Rockwell Collins provides aircraft simulation and training solutions, Government defense displays and navigation systems, commercial aviation flight controls, flight displays, flight management, and head-up guidance systems.

c. Mercury Computer Systems is developing a new, high-end platform for Synthetic Vision Systems which include graphics processing capabilities with a dedicated graphic accelerator designed to run graphic intensive applications. The company also provides multifunction flight displays with 3D synthetic vision.

d. Universal Avionics offers flight management systems, navigation sensors, terrain avoidance and warning systems, flat panel integrated displays, and the Vision-1 synthetic vision system egocentric 3D view. Their cockpit display unit is an electronic flight bag system which provides the pilot with supplementary electronic displays integrated with flight deck instrumentation.

e. Raytheon supplies airborne radars and processors, electro-optic/infrared sensors, electronic warfare and precision guidance systems, space and missile defense technology and intelligence, and active electronically scanned array radars.

f. GB Tech's software expertise is based in configuration management; risk management support; and software tool development, maintenance, verification, and validation.

g. Muniz Engineering currently provides MPCV technical support in the area of systems engineering and development which includes tasks for requirements analysis; risk management; evaluation of aero-coefficients such as drag, lift, and moments of inertia and shock interference effects during supersonic flight; aerothermal heating during re-entry and launch vehicle ascent; guidance, navigation, and control requirements; verification and conceptual level design for the ascent, abort, and re-entry phases; and dynamic loads and environments analysis for the definition of design loads, vibration, shock, and acoustic environments.

h. AANA is presently performing the work satisfactorily under Contract NNJ08TA62B. Work on previous contracts since July 2006 includes the CCPP1C, NNJ06HC04P; the CCPP2C, NNJ06TA10B; and the CCPP3C, NNJ09TA62B. CCPP1C, CCPP2C, and CCPP3C were awarded non-competitively to AANA based on FAR 6.302-1, only one responsible source and no other supplies or services will satisfy Agency requirements.

From the review of these companies' expertise and list of products, it was determined that AANA is the only technically acceptable source. None of the other companies possesses the specific experience required to provide the required service in the required timeframe. Major factors in this conclusion were the lack of next generation spacecraft human machine interface rapid prototyping experience or comparable experience required by the Government to successfully perform this work. These companies do not possess the required background and experience necessary to successfully execute the required prototyping processes which have evolved over 5 years.

Based on this market study, it was concluded that only AANA can provide expertise that can meet the Government's technical requirements and delivery schedule.

8. Other facts supporting the use of other than full and open competition:

a. Explanation of why technical data packages, specifications, engineering descriptions, statements of work, or purchase descriptions suitable for full and open competition have not been developed or are not available.

The Orion MPCV Cockpit Prototyping Project requires the application of human machine interface rapid prototyping techniques to the design and implementation of next generation spacecraft display and control systems. Commercial manufacturers do not offer rapid prototyping solutions for next generation spacecraft displays and controls such as those developed through CCPP1C, CCPP2C, CCPP3C, the X-38/CRV human machine interface research and development, the ACES, and the Sensor Fusion Project.

b. When 6.302-1 is cited for follow-on acquisition as described in 6.302-1(a) (2) (ii), show an estimate of the cost that would be duplicated and how the estimate was derived.

See attached spreadsheet.

c. When 6.302-2 is cited, show data, estimated cost, or other rationale as to the extent and nature of the harm to the Government.

Not applicable.

9. A listing of sources, if any, that expressed in writing an interest in the acquisition:

A synopsis for this effort was issued on the NAIS on November 19, 2013, and closed on December 9, 2013. One response was received from Joe Clay, of Spacedesign Corporation.

Based on the review from the technical organization, Spacedesign Corporation did not demonstrate their capability to execute the current Statement of Work.

10. A statement of the actions, if any, the Agency may take to remove or overcome any barriers to competition before any subsequent acquisition for the supplies or services required:

The Agency will continue to monitor the market for other sources that can meet the Government's technical specifications and delivery schedule. Any inquiries and/or capability/qualification statements received as a result of the synopsis will be considered to determine if the Government should conduct this procurement on a competitive basis.